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(54) Gaming machine with bonus mode

(57) A gaming machine is operated by a programmed micro-processor in which the first mode of operation, a basic gambling game, is implemented such as video poker or reel-type slot machine play. If bonus symbols are selected in the basic mode, a bonus mode is triggered. In the bonus mode the same or a different game is implemented by the micro-processor system employing a Bernoulli trial procedure in which the player continues to play and receive awards until a losing combination occurs. The hit rate for the bonus mode is greater than 50% although the overall pay out percentage of the game remains below 100%.

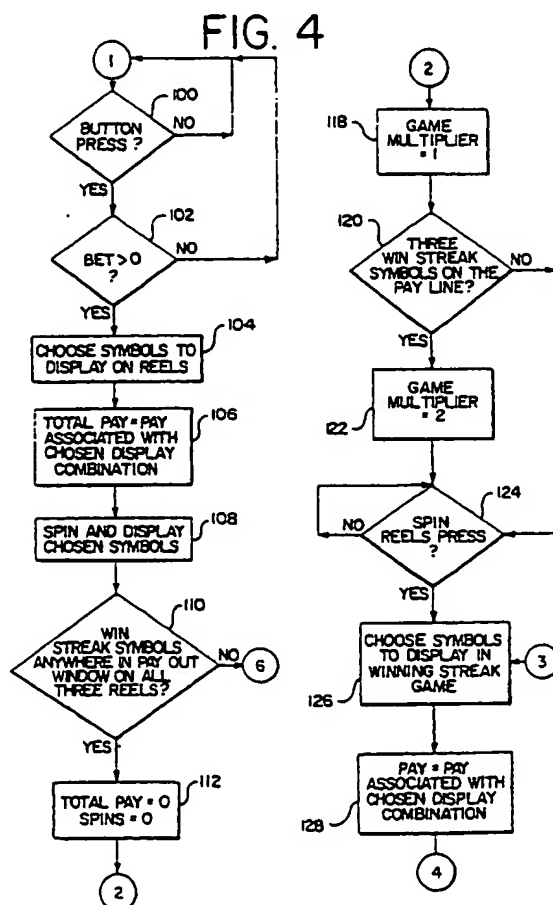
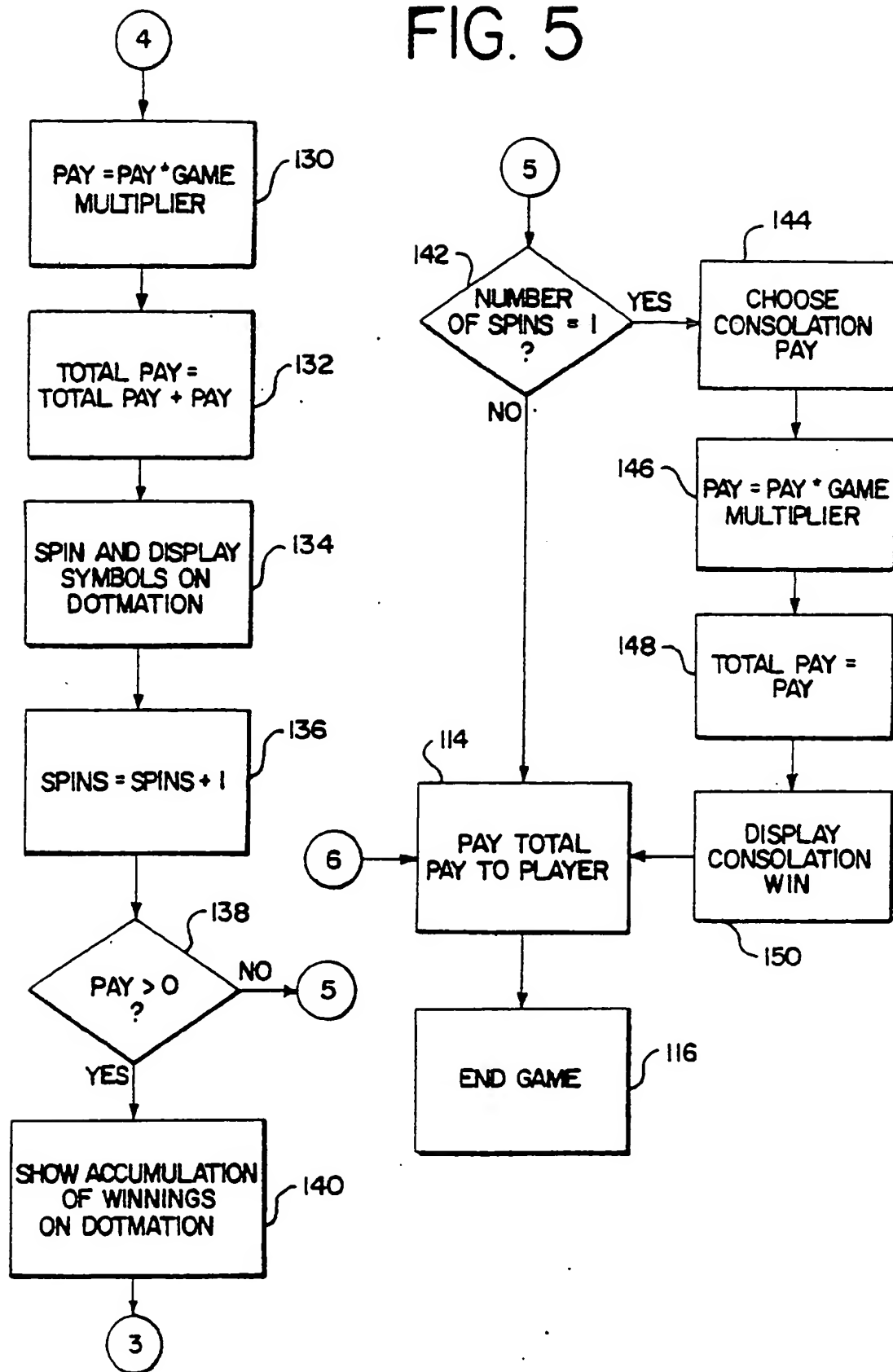


FIG. 5



Description

BACKGROUND OF THE INVENTION

This invention relates to gaming machines. More specifically, it relates to gaming machines of the type used in casinos. Such devices include the familiar spinning reel slot machine, video slot machines, video display poker games and the like. Spinning reel slot machines have maintained their popularity evolving from electro-mechanical devices to the present day devices which employ micro-processor control. In modern devices the spinning reels are used merely as a display to advise a player if he has won or lost a game of chance played entirely in computer memory according to the rules embedded in a computer program. Video display type gaming machines are similar in terms of their computer program and operation but, in place of spinning reels, a CRT or dot matrix display is provided upon which a simulation of a desired game is presented. For example a poker game, a spinning reel slot machine, a black jack game or other casino game may be simulated on the display. Whether the gaming machine uses spinning reels, a CRT display or some other manner of informing the player of game outcomes, it is necessary that the casino owner make a profit. To that end the game will be percentaged so that some portion of the revenue played into the machine is retained as profit. Thus for every dollar played, on average, a typical gaming machine will retain (hold) between 1% and 25%.

With the constraint that there must be a positive hold percentage comes the problem of offering higher awards to induce players to use the equipment. In reel spinning slot machines this has been a formidable problem because the possible outcomes are normally related to the number of stop positions per spinning reel. Thus, in the case of three reels each having 20 stop positions thereon, the probability of any three-symbol combination occurring is one in eight thousand. This provides an upper limit on the amount that may be paid out if a profit is to be made. In an effort to overcome this limitation micro-processor based machines have been developed. The game is played in the micro-processor system and the reels are used merely to display the results. Much greater odds may be employed than permitted by the reel strip size thereby increasing the possible payouts by decreasing the chances that a winning combination will occur.

Patent No. 4,448,419 to Telnaes provides one solution to this problem. It is desired, however, according to the present invention, to provide a more universal solution which pays high awards while at the same time increasing player enjoyment. The present invention is suitable for implementation in a reel-type slot machine design as will be explained in the description of a preferred embodiment. However, it may also be implemented strictly as a video game, without the use of spinning reels, or it may be used for other types of games or for

combinations of games. All that is required is that there be a standard type base game which has a hold percentage built into its table of payouts. In addition, the base game must include a special symbol combination or similar mechanism by which a lucky player can qualify to play a bonus game. The bonus game may be similar to the base game, albeit with different symbol probabilities or it may be a completely separate game on the same or a different display. Thus for example, in a preferred embodiment a reel spinning slot machine is used for the base game while a dot matrix display simulation of a slot machine or card game is used for the bonus game. The pay tables for the basic and bonus games must be mathematically combined such that there is still a positive hold percentage, which represents the profit for the casino establishment. Other combinations of games are clearly suitable for use with the present invention such as a reel spinning slot machine in which the basic game uses a first set of symbol probabilities and the bonus game uses a second set of symbol probabilities. Another possibility is a video poker game for the base game and wherein the bonus game could be a video slot game, or another poker game with a different pay table.

A principal feature of the present invention is the structure of the bonus game. A player must play the base game until he qualifies for the bonus game. Qualification is a low frequency event. The bonus game however is a high hit rate game in which the player is expected to win several times in a row and wherein the player is permitted to keep playing and collect his winnings (with or, optionally, without payment of additional coins by the player) until he loses. In the context of a reel-type slot machine, this may be referred to as a "spin 'til you lose" bonus game. It is believed that the thrill and excitement of a bonus game in which a player's probability of winning is significantly greater than 50% and in which he keeps playing until he loses, all the while collecting payouts, will add a new and significantly greater level of player excitement.

It is accordingly an object of the present invention to provide a gaming machine in which there is a basic game and a bonus game and wherein the bonus game has a play-until-you-lose-mode in which the probability of winning each trial in the bonus game is greater than 50%.

It is another object of the invention to provide a combination gaming machine having basic and bonus modes wherein the basic mode occasionally initiates the bonus mode game which is a high hit-rate game in which the player may continue to play until he loses.

It is a further object of the invention to provide a dual mode gaming machine in which a bonus mode has a hit rate of greater than 50% and which is based upon a series of Bernoulli trials which continue until the player loses.

These and other objects of the invention will be apparent from the remaining portion of this specification.

qualified
*
Spin
till
you
lose

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a simplified illustration of a spinning reel slot machine having a dot matrix display suitable for use with a bonus mode according to the present invention.

FIGURE 1A is an enlargement of the slot machine display showing how symbols appear on, above and below the payline.

FIGURE 2 is a symbol table for a 22 symbol reel-type slot machine augmented to include bonus symbols (WinStreak) and special blanks (WSBlank) immediately adjacent to the bonus symbols.

FIGURE 2A is a math table combining the expected value calculation for the base and bonus games according to an embodiment of the invention.

FIGURE 2B is a set of reel strips for the symbol table of FIGURE 2 for a base game.

FIGURE 3 is a combined symbol and math table for the bonus game according to an embodiment of the invention.

FIGURE 3a is a pay table for both the base and bonus games.

FIGURES 4 and 5 are software flow diagrams illustrating how the invention may be implemented.

FIGURE 6 is a graph of the Geometric function for Bernoulli trials according to an example of the invention.

FIGURE 7 is a consolation table for an optional feature of the invention.

DETAILED DESCRIPTION

As indicated in the background portion of this specification, the present invention can be implemented using almost any type of gaming device. The game is divided into two parts: a basic game and bonus game. The basic game can be any type of game of chance. Typically it will be a spinning reel slot machine, a video poker game or similar type of game suitable for wagering. In the basic game, some event, or sequence of outcomes which occur at a low frequency permits the playing of the bonus game. The bonus game is another game of chance with a very high hit rate (i.e., the probability that a player will win rather than lose). The hit rate in the bonus game, according to the present invention, should be greater than 50% and is most effective when selected to be greater than 70%. When a trigger event occurs in the base game, play switches to the bonus game. Preferably, play of the bonus game results in a series of free trials i.e., not requiring the game player to insert any additional coins or credits into the machine. Alternately, however, the bonus game can be played by requiring coins or credits with the player knowing that his chance of winning has been significantly increased. If a bonus game trial results in a win, then the player receives the amount associated with that particular win and another play or trial occurs. Trials continue in the bonus game until a losing trial occurs.

As indicated previously, the basic game and bonus game may be the same game system with different pay tables and rules. For example, a video poker game could be the base game where a particular hand, such as four-of-a-kind is required to trigger operation of the bonus game. The bonus game however, although the same video poker game, would have a more favorable pay table offering a much higher hit rate. This could also be accomplished by the use of wild cards or other changes to the game rules.

It is also contemplated that the base game and bonus game could be executed on the reels of a spinning reel slot machine where the symbols on the reels are given two different sets of probabilities for the base and bonus games. Another alternative is for the two games to be very different, such as a spinning reel slot machine for the base game coupled with a video poker game as the bonus game. It is also contemplated, and disclosed herein as one preferred embodiment, to use a spinning reel slot machine as the base game and a video display type slot machine simulation as the bonus game.

Thus, referring to FIGURE 1, there is shown a simplified diagram of a reel-type slot machine. The machine 10 includes a display window 12 through which a player may observe three spinning reels, 14, 16 and 18. Game play is initiated by inserting a coin or playing a credit and then pulling the lever 20 or operating a push button switch for the same purpose. A micro-processor then operates according to its game program randomly selecting a reel stop position for each of reels 14, 16 and 18. The reels are set in motion to give the player the feeling of randomness, but in due course the reels are stopped at the preselected stop positions using technology well known in this art which typically includes stepper motors for driving the reels and stopping them at the desired position under processor control. A payline 22 is located centrally of the display 12. Symbols which stop on the payline are evaluated to determine if a winning combination has occurred. If so, in a typical slot machine, a payout is made and the game is over. In some games the symbols above and below the payline are also visible in the display window. This provides additional excitement to the player. In some games, the ability to see the next symbol, above and below the payline, can be used to provide additional entertainment and payoff features. Thus, for example as shown in FIGURE 1A, which is an enlargement of the display window 12, three symbols are visible on Reel 14. Symbol A is on the payline, while symbol B is above the payline and symbol C is below the payline. The present invention makes use of this feature of traditional slot machines in a manner to be explained hereafter. With reference to the programming and operation of processor controlled slot machines, the reader is directed to the disclosures in the following U.S. Patents 4,095,795 to Saxton and 5,456,465 to Durham which are hereby incorporated by reference.

49-
1CND

hit rate
750%

No
additional
wager

Above
payline
Below

slot
machine

DESCRIPTION OF A PREFERRED EMBODIMENT

Returning to FIGURE 1, according to a preferred embodiment of the invention, the slot machine 10 is provided with a video-type display 32 which may be a CRT or a dot matrix display, as desired. The display is housed in a vertically disposed enclosure secured to the upper portion of the slot machine 10. The display 32 is used for purposes of playing a bonus game. If the bonus game is a poker game for example, a poker hand would be shown on the display and the player paid if a winning hand occurs. Similarly, if the bonus game is a slot machine simulation, spinning symbols would be simulated on the display stopped in various combinations, some of which would constitute winners.

There will now be described one embodiment of the invention, which is currently preferred, for implementing the game in a commercial environment. It must be reiterated that this is only one such possibility and that any combination of two suitable games that are percentaged and interoperable according to the present invention may be used. The basic game is played on the spinning reels of the slot machine 10, while the bonus game is played on the dot matrix display 32. The basic game has typical symbols such as Cherry, Single Bar, Double Bar and Triple Bar spaced on the reel strips 14, 16 and 18. Typically these symbols will be randomly displayed on the reel strips, usually separated by a blank, which is itself a symbol. In addition to these standard slot machine symbols, the reel strips also carry a bonus symbol, the selection of which leads to operation of the bonus game as will be described.

FIGURE 2 is a table illustrating the reel strip symbol frequency for the base game. The symbols which appear on Reel 1 include: the WinStreak or bonus symbol, the "special" WinStreak blanks on either side of the WinStreak bonus symbol, the 3Bar, 2Bar and 1Bar symbols plus regular blanks and cherries for a total of 22 symbols one at each of 22 reel stop positions. Reels 2 and 3 are similar. A typical symbol layout for this example is shown in Figure 2b. The occurrence of the various symbols varies from reel to reel, but each reel has but 22 symbols in all and therefore the odds of any possible combination of distinct symbols appearing on the payline is 1 in 10,648 ($22 \times 22 \times 22$). Thus, according to a preferred implementation of the invention, the base game may be a standard processor controlled spinning reel slot machine, augmented however, with bonus symbols and special blanks. It is substantially similar to the system described in U.S. Patent No. 4,095,795 to Saxton, albeit a different software algorithm is employed for selecting the symbols.

As with most such games, the payout table is set so that the machine retains a percentage of the money played (the hold percentage). Calculation of the hold percentage of the machine however requires inclusion of the bonus game. For illustrative purposes, a typical pay schedule for the reel strips of FIGURE 2 is shown

in FIGURE 2A. The schedule includes the calculated payouts for the bonus game as will be discussed hereafter. FIGURE 2A also shows the probability of occurrence of winning combinations and the expected value (EV) from which the hold percentage is calculated. Thus for the reel strip of FIGURE 2, the probability of 3 bars occurring is 0.000376 and since it pays 50 coins the EV is $(50 \times .000376) = 0.018783$. By summing the EV's for all winning combinations, including the bonus game combinations represented in the schedule as "3WinStreak and "3AnyStreak", it can be determined that the illustrated embodiment has a hold percentage of 94.4045. That is, for every dollar played, on average, about 94 cents will be returned to the player and 6 cents will be retained as profit.

In the basic game when three bonus symbols appear in the display 12 (either on the payline or above or below the payline) the bonus game is initiated. If the three bonus symbols are on the payline, according to the described embodiment, the bonus game is initiated with all awards doubled. According to the preferred embodiment, the bonus game is implemented in a dot matrix video display shown at 32 in FIGURE 1. This display is utilized by the processor to simulate a spinning reel slot machine. The symbols used in the bonus game are Cherry, Single Bar, Double Bar, Triple Bar, Blue 7 and Red 7. This is shown in the pay table of FIGURE 3. As will be apparent in this example, some symbols appear in the bonus game which do not appear on the basic game reel strips. For simplicity, it is preferable, but not necessary that the bonus game and basic game use the same pay table for common symbols i.e., the same award for 1 or 2 Cherries, and for Any Bar, Single Bar, Double Bar and Triple Bar combinations. Typically posted on the outside of the machine is such a combined pay table including the awards for the 3 Cherries, Any 7, Blue 7 and Red 7 which are only available in the bonus game.

In the illustrated implementation, there are 22 reel stop positions on each of 3 reels of the basic game (See FIG. 2). The machine uses a probability of 1 in 22 for each reel stop position on each reel. The bonus symbols (WinStreak) appear two times (at two stop positions) on the 1st reel, three times on the 2nd reel and once on the 3rd reel. Thus, the probability of 3 WinStreak symbols on the payline has a probability of $(2 \times 3 \times 1) / (22 \times 22 \times 22) = .0005634861 = A$. This is the equal to 1 in 1774.667 spins. Preferably, the multiple instances of the WinStreak symbol on reels 1 and 2 are placed at least 4 stop positions apart such as shown in Figure 2B. As a result, the blanks above and below the WinStreak symbols will put a WinStreak bonus symbol within one position of the payline. This provides 3 times the number of reel stop positions as there are WinStreak Symbols which may trigger the bonus game. The probability of entering the bonus game is $(6 \times 9 \times 3) / (22 \times 22 \times 22) = .0152141247 = B$. In summary, a 2X multiplier bonus game (3 WinStreak symbols on the pay-

bonus symbol

Key Feature

Multif
3 bonus symbols
double award

low rate
hit = 85%
spin-f.l. = 2nd
y u - lose

line) will be achieved with a probability of A. The probability of a regular bonus round played with a 1X multiplier is B-A.

A principal feature of the invention is the high hit rate of the bonus game coupled with the spin-til-you-lose concept. The following discussion of the bonus game mathematics will focus on a single coin implementation. It is well known how to extend this to 2-coin, 3-coin, 5-coin or other versions allowing more than one coin to be wagered on each base game.

The expected return on a slot machine is computed by combining the probability of each award with the amount of the award as indicated in FIGS. 2 and 3. The expected value (EV) of each award is computed by taking the product of the probability of achieving the award and the number of coins awarded. The sum of each of these products results in the expected return of the slot machine. This result will be in the form of a fraction of 1 coin. The return of the combined game, (basic and bonus games) according to the invention is computed by using this method for each regular symbol combination of the base game, to which is added the expected value of the bonus game combinations. The expected value of the bonus game is computed by multiplying the probability of getting to the bonus game by the expected number of coins awarded in the bonus game. Call the expected value (EV) for coins won in the bonus game "C". The value "C" is formed from two entries. Entry 1 is the probability of playing the bonus round with a 1X multiplier B-A from the preceding discussion times the EV of the bonus game or $((B-A) \cdot C)$. Entry 2 is the probability of playing the bonus round with a 2X multiplier (A), times the EV of the bonus game times two or $(A \cdot C \cdot 2)$. To obtain the value C requires additional information.

The expected value for each spin of the bonus game is computed in the same manner described above, computing the sum of expected values for each possible award. While any commercially successful slot machine must have an expected value of less than 1.00 this restriction does not apply to the bonus game per se. According to the present invention, as long as the value C, when inserted into the expected value equation for the entire game, results in a return for the entire game of less than 1.00, the expected value for the bonus game may be greater than 1.00. The expected coins per spin of the bonus game in the example is X coins. By computing S, the expected number of spins until a loss occurs in the bonus game, C is then computed as the product of this number of spins, times the coins expected per spin, X. That is $C = S \cdot X$.

According to the invention, the bonus game has a hit rate greater than 50% and preferably greater than 70%. Assuming an 85% hit rate, for example, on each spin the probability of losing is approximately 0.15. The bonus game program is configured such that a player continues playing until he loses. One of ordinary skill in probability theory will recognize this mode of operation as a series of Bernoulli trials with $p=0.15$. That is, a suc-

cession of trials (spins) each with a 0.15 probability of "success". Note that the probability expressed in a Bernoulli trial is usually referred to as the "probability of success" of that trial, but as applied to the bonus game the "success" of a trial corresponds to losing the game (i.e. a non-winning spin). For more information on Bernoulli trials see, for example, Hogg and Tanis "Probability and Statistical Inference" 4ed. pp. 150-171, 1993 Prentice-Hall Inc.

The function that shows the probability of "trials until success" of a Bernoulli function (in this case the number of trials until we achieve the 0.15 probability loss) is called the Geometric function (see FIG. 6). This assumes p remains constant. It is permissible for p to vary but the expected trials until success is more difficult to compute. The probability of first success (loss on the bonus game after 1 trial) is 0.15. The probability of success (loss on the bonus game) after 2 trials is $0.85 \cdot 0.15 = 0.1275$. For three trials, the calculation is $0.85 \cdot 0.85 \cdot 0.15 = 0.108375$ and so on. It is well known that the expected value (EV) of the Geometric function is $1/p$ where p is the probability of "success" on a given trial (i.e. loss on the bonus game). Therefore, S the expected number of spins of a bonus game with a hit rate of 85% is $1/0.15 = 6.667$. Note this includes the final losing turn. The expected value (C) for this bonus game may be computed by multiplying the value of S (6.667) by the expected return per spin (X). That is $C = S \cdot X$.

In practice, it is desirable to vary the payout percentages slightly. Accordingly, the bonus game may be modified to have either a different hit rate or a different average coins per spin value by adjusting the symbol probabilities stored in the computer program. FIG. 3 is an example of such an adjusted pay table. For the example of Figure 3, the value X, the expected return per spin is 4.1751 (the sum of the EV column) while the hit rate is 84.41% producing a value of $S = 6.4145$. Thus $C = 6.4145 \cdot 4.175 = 26.781$.

Referring to FIG. 2A the computed values C and 2C (for the 2X multiplier feature) appear in the pay column as the first two entries and are included in the EV column computations which sum to a 94.4045% hold. Thus the expected win for the bonus game is combined with the expected win of the base game to determine the expected value of the combined game. Note that the pay column uses a value of $C = 27.733$ rather than 26.780. This is due to the use of the consolation feature described in connection with Figures 5 and 7.

From the foregoing, it will be understood that the present invention provides a bonus game based on Bernoulli trials in which a player, who qualifies by playing the base game, can play the bonus game on a spin-til-you-lose basis. The bonus game has a hit rate of greater than 50%, preferably higher than 70%. As a result, the player has a strong inducement to "endure" the base game in order to qualify for bonus game play in which he is statistically likely of winning several times in a row and collecting relatively large payouts, while still return-

Includes
final
losing
turn

Bernoulli

ing a profit for the casino establishment.

By providing a two stage gaming process in which a traditional game of chance is played as the base game, the existing concept with which players are familiar and comfortable is retained. At the same time, however, a significantly more exciting feature is added in the form of a bonus game. The software implementation of the invention, according to the described embodiment, is relatively straightforward and will be easily understood by those skilled in the art. As the specific programming is dependent upon the hardware employed, including the type of micro-processor selected, it is not useful to provide detailed software listings. For completeness, however, FIGS. 4 and 5 contain flow diagrams of the manner in which the base and bonus games are implemented in a processor based system. From these diagrams, those skilled in the art will be readily able to program the invention described herein.

Referring to Figures 4 and 5, initially the processor waits until the player has pulled the handle or pressed a switch to initiate operation of the game. In addition, it is required that the player has placed a bet, i.e., that the amount wagered is greater than zero (Steps 100 and 102). The processor then uses any well known and accepted random number generator algorithm to choose the symbols for display on the reels of the base game (Step 104). A tentative value, Total Pay, is computed based upon a pay table (see, for example, Figure 3a) for the selected symbol combination (Step 106). The reels 14, 16 and 18, in the case of the slot machine 10 of Figure 1, are spun for a period of time and then stopped so that the symbols selected appear on the payline (Step 108). Before awarding credits to the player, in the event a winning combination appears on the payline, the program, according to the present invention, first checks to see if 1 WinStreak symbol appears on each reel (Step 110). If so, a bonus game has been earned and the program branches to Step 112 setting the total pay value to zero and the spin count to zero in preparation for initiating operation of the bonus game. If WinStreak symbols do not appear on each reel, either on the payline or above or below the payline, then the program branches to the circle labeled 6 in Figure 5 where the tentative total pay computed in Step 106 is paid or credited to the player (Step 114) and the game ends (Step 116). As thus far described, this is the operation of a standard slot machine because the bonus feature was not invoked. The player must continue playing the game as described until a WinStreak symbol appears on each reel within the pay window to initiate operation of the bonus game.

When that occurs, the program, at Step 112, branches to the bonus game indicated on Figure 4 beginning at the circle labeled 2. At Step 118 the bonus game multiplier is set equal to one. The program then checks, at Step 120, to determine if the three WinStreak symbols are on the payline. If so, the game multiplier is reset to two (Step 122). In either case, the program then

proceeds to wait for the player to initiate operation of the bonus game by pressing a button or pulling a lever at Step 124. This initiates operation of the bonus game display, which in the illustrated embodiment, is played on the dot matrix display 32 of Figure 1. The processor again uses its random number algorithm to choose the symbols to be displayed for the bonus game (Step 126). A value "Pay" is set equal to the number of coins associated with the chosen display combination at Step 128 and the program continues as shown in Figure 5 in the circle numbered 4. The Pay value is multiplied by the game multiplier (Step 130) as a function of the outcome of the decision box 120. A cumulative value, Total Pay, is computed as being equal to the previous Total Pays plus the current Pay (Step 132). The program next goes through the process of providing an animation of spinning reels on the dot matrix display and as the reels appear to stop, the selected symbols appear (Step 134). The spin value is then incremented (Step 136) in preparation for the next cycle of the bonus game. Before commencing the next cycle, however, it is determined at Step 138 if the player has won or lost. If he has won, the accumulated winnings are displayed to the player at 140 and the next cycle of the bonus round commences by branching back to Figure 4 beginning at the circle labeled 3.

If, however, it is determined at Step 138 that the player has lost, the program branches to the circle labeled 5. The program then determines whether the value of the spin counter is equal to one, indicating that the player lost on his first turn in the bonus round (Step 142). If so, according to a preferred embodiment of the invention, a consolation award is given. The program chooses a consolation pay amount (Step 144) using a random selection algorithm based, for example, on the second chance table illustrated in Figure 7. Figure 7 tabulates the possible pays as a consolation amount to a player who has achieved the bonus round but lost on the first spin. The random selection includes amounts of from three to fifty coins to be paid to the player. Figure 7 illustrates for each of the possible pay selections, the number of such selections among a schedule of 100 memory locations. Thus there are 32 pays of 3 coins, 45 pays of 5, 20 pays of 10, 2 pays of 20, and but one pay of 50 coins. The expected value for this additional payout is provided in the fourth column of Figure 7 as 6.11 coins. Since the probability of losing on the first spin is 0.1559 this adds an expected value to the overall game of .952536 as illustrated in Figure 7 and this is added to the expected win value shown in Figure 3 as 26.78072 to obtain the overall payout shown in Figure 2a of 27.73326.

After the processor chooses a consolation pay amount, the chosen pay amount is multiplied by the game multiplier (either one or two) and the total pay is set equal to the multiplied pay amount (Steps 146, 148). Finally, the amount of the consolation win is displayed, Step 150, and then payment is made at Step 114.

multiplier

accumulated
winnings

lose

lose
on
1st
turn

If the bonus round loss occurs after the first spin, the program goes from Step 142 to Step 114 where the player is credited with the Total Pay won to that point and the game ends at Step 116.

In summary, the disclosed embodiment plays a basic game on a reel type spinning slot machine and a bonus game on a dot matrix display which may be another type of game or a simulation of a reel type slot machine. As shown in Figures 4 and 5, the basic game and bonus game operate in a similar manner in a preferred embodiment. With respect to the bonus game, however, a first Bernoulli trial commences. Symbols are selected for display, a simulated reel spinning animation, poker display etc. is provided and then the simulation stops to show the player the selected symbols. If the combination on the payline or the poker hand is a winner, the number of coins determined by the pay table is credited to the player's account. Then a further Bernoulli trial or operation of the game occurs. This continues as long as each trial produces a winning combination. In this manner, the player can quickly accumulate a significant bonus since the hit rate for the bonus game is desirably greater than 50% and preferably greater than 70%. For a typical game (i.e. hit rate approximately equal to) designed according to the invention, it will take between 5 and 6 Bernoulli trials before a losing combination occurs in the bonus game, providing the player with a large bonus and a great deal of excitement as he watches his winnings mount. When, at last, a losing trial occurs, the game is over (unless a loss occurs on the first trial and the optional consolation or second chance feature is employed). It should be noted that the Geometric function has a non zero probability for any number of trials. That is, on occasion 10, 20, 50, 100 or more successive wins in a row are possible.

There have been various spinning reel slot machine models that include a feature that will cause the machine to repeatedly spin the reels until a winning combination appears. Examples of such machines are WMS Gaming's "Jackpot Stampede" and IGT's "Spin 'til you win". These models have some added appeal but the shortcoming is that the player's expectation is crushed once he or she realizes that there is a high likelihood that the first winning combination to hit will be one of the "small" awards (i.e. one cherry). It is believed that no one has heretofore designed a game according to the present invention that allows a player to spin until he loses, collecting all wins along the way.

The present invention provides a high hit rate bonus game, so that the expected number of spins until a loser occurs is greater than 6 for the described embodiment and the player's winnings adds up quickly. As the successive Bernoulli trials "fail" (thus extending the game) the player is winning more and more money. As FIG. 6 shows the probability of the number of spins is asymptotic to zero. This means that there is a non-zero probability for each spin count and the bonus game will, on occasion run through a tremendous number of spins ac-

cumulating large rewards, something that has never been offered before. The joining of a high hit rate bonus game to a traditional base game is the key to the excitement of this feature.

While preferred embodiments of the present invention have been illustrated and described, it will be understood by those of ordinary skill in the art that changes and modifications can be made without departure from the invention in its broader aspects. Various features of the present invention are set forth in the following claims.

Claims

1. A processor controlled game of chance comprising:

a) a processor, operating according to a game program, for randomly selecting symbols and for awarding credits when winning symbol combinations are selected;

b) display means on which said selected symbol combinations are displayed to a game player;

c) said processor operating in a basic mode unless and until a symbol combination, designated as a bonus combination in said game program, is selected, said processor, in said basic mode, selecting symbols and awarding credits or money in response to the input of money or credits by said player;

d) said processor operating in a bonus mode after said bonus combination is selected, said processor, in said bonus mode: (1) selecting symbol combinations as a sequence of Bernoulli trials; (2) displaying the symbol combinations for each trial; (3) awarding credits for winning combinations associated with each trial until a losing combination is selected, said bonus mode having a hit rate for winning combinations in excess of fifty percent;

whereby a player who reaches the bonus mode accumulates credits as a function of the number of Bernoulli trials survived.

2. In a gaming machine including processor means for randomly selecting outcomes, some of which are winners and the remainder being losers; and for awarding credits or money corresponding to said winners, and display means for displaying the selected outcomes the improvement comprising:

a) said processor means being programmed to designate certain outcomes as a bonus event

permitting the play of a bonus game;

b) said processor, during bonus game play, iteratively and randomly selecting outcomes as a sequence of Bernoulli trials, displaying said outcomes and awarding the credits associated therewith until a losing outcome is selected, said bonus game having a hit rate for winning combinations in excess of fifty percent;

whereby a player who reaches the bonus game accumulates credits as a function of the number of Bernoulli trials survived.

3. A method of operating a gaming machine having a processor for randomly selecting game outcomes and for awarding credits or money for winning outcomes and, a display for displaying said outcomes to a game player comprising the steps of:

a) operating said processor in a basic mode unless and until an outcome, designated as a bonus event, is selected, said basic mode permitting outcome selection, display and credit awards only in response to the input of a credit by said player;

b) operating said processor in a bonus mode after said bonus event is selected, said bonus mode operation causing:

(1) random selection and display of outcomes as a sequence of Bernoulli trials which continue until a losing trial occurs;

(2) the award of credits or money for winning outcomes for each trial, said bonus mode having a hit rate for winning outcomes in excess of fifty percent;

whereby a player who reaches the bonus mode accumulates credits as a function of the number of Bernoulli trials survived.

4. The device of Claim 1 wherein said processor is programmed to select poker symbols for the basic mode game.
5. The device of Claim 1 wherein said processor is programmed to select poker symbols for the bonus mode game.
6. The device of Claim 1 wherein the display means includes a video display on which the symbols are displayed for the basic game.
7. The device of Claim 1 wherein the display means includes a video display on which the symbols are

displayed for the bonus game.

8. The device of Claim 1 wherein the display means includes at least two physical reels having symbols arranged thereon, the selected symbols being displayed to a player by rotation of said reels.

9. The device of Claim 8 wherein said reels are used as the display for the basic game.

10. The device of Claim 8 wherein said reels are used as the display for the bonus game.

11. The device of Claim 1 wherein said display means includes: (a) a reel type display on which selected symbols are displayed to a player by rotation of said reels; and (b) a video display on which symbols may appear;

one of said displays being used for said basic game, the other being used for the bonus game.

12. The device of Claim 1 wherein said processor is programmed to produce an expected value (EV) for said bonus mode greater than 1.0 but wherein the EV of the combined basic and bonus modes is less than 1.0.

13. The device of Claim 2 wherein said processor is programmed to produce an expected value (EV) for said bonus mode greater than 1.0 but wherein the EV of the combined basic and bonus modes is less than 1.0.

14. The method of Claim 3 wherein said processor is programmed to produce an expected value (EV) for said bonus mode greater than 1.0 but wherein the EV of the combined basic and bonus modes is less than 1.0.

15. In a gaming machine including processor means for randomly selecting outcomes, some of which are winners and the remainder being losers; and for awarding credits or money corresponding to said winners, and display means for displaying the selected outcomes the improvement comprising:

a) said processor means being programmed to designate certain outcomes as a bonus event permitting the play of a bonus game;

b) said processor, during bonus game play, iteratively and randomly selecting outcomes each of which is a Bernoulli trial, but wherein p, the probability of success may vary;

c) displaying said outcomes and awarding the credits associated therewith until a losing outcome is selected, said bonus game having a hit

rate for winning combinations in excess of fifty percent;

whereby a player who reaches the bonus game accumulates credits as a function of the number of Bernoulli trials survived. 5

16. The device of Claim 15 wherein said processor initiates a consolation trial if the first Bernoulli trial during bonus game play results in a losing outcome, said consolation trial awarding a randomly determined number of credits as a consolation prize. 10

17. The method of Claim 3 further including the step of:
c) initiating a consolation trial if the first Bernoulli trial during bonus game play results in a losing outcome, said consolation trial awarding a randomly determined number of credits as a consolation prize. 15
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FIG. 1

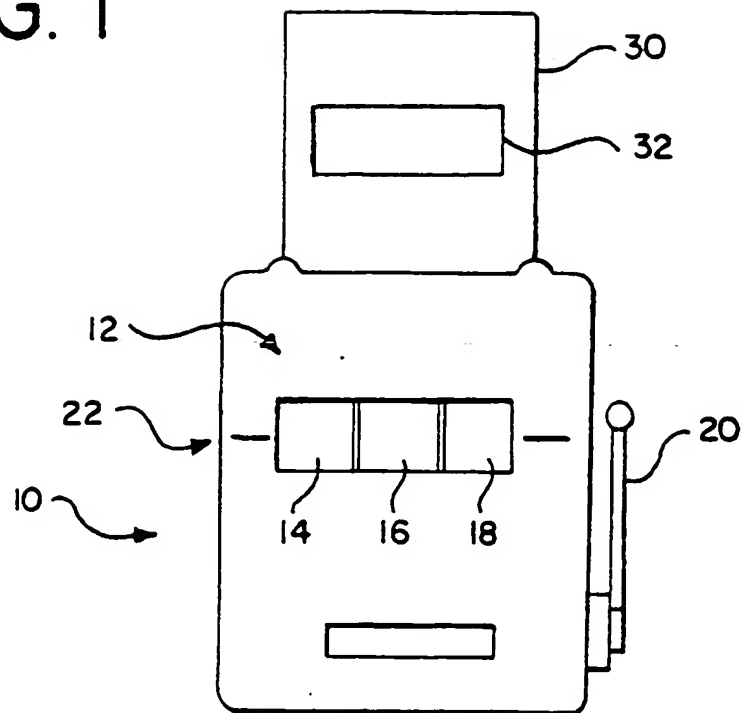


FIG. 1A

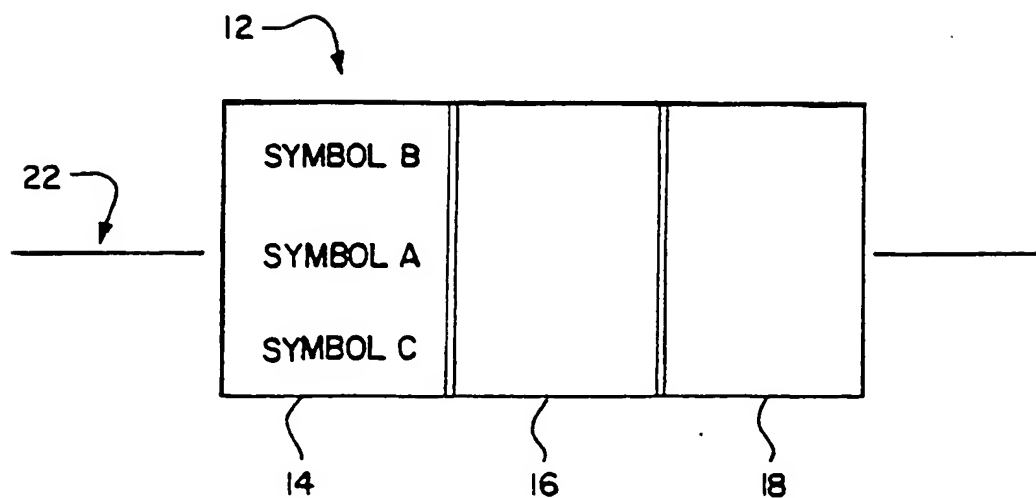


FIG. 2

BASE GAME				
BASE GAME	REEL1	REEL2	REEL3	
SYMBOLS				
WINSTREAK	2	3	1	
WSBLANK	4	6	2	
3BAR	4	1	1	
2BAR	3	2	2	
1BAR	2	4	6	
BLANKS	7	5	9	
CHERRY	0	1	1	
	22	22	22	

FIG. 2A

COMBINED GAME PAY SCHEDULE					
COMB	PAY	PROB	EV	PULLS	MAXCONT
3WINSTREAK	55.46652	0.000563	0.031255	1774.667	3.310713
3ANYSTREAK	27.73326	0.014651	0.40631	68.25641	43.03927
3BARS	50	0.000376	0.018783	2662	1.989617
2BARS	20	0.001127	0.022539	887.3333	2.38754
1BARS	10	0.004508	0.045079	221.8333	4.77508
ANYBAR	5	0.047239	0.236195	21.16899	25.01943
2CHERRY	5	0.002066	0.010331	484	1.094289
CHERRY	2	0.086777	0.173554	11.52381	18.38406
		0.157307	0.944045		

FIG. 2B

BASE GAME REELSTRIPS				
	REEL1	REEL2	REEL3	
1	2BAR	2BAR	1BAR	
2				
3	3BAR	1BAR	2BAR	
4				
5	STREAK	STREAK	1BAR	
6				
7	1BAR	3BAR	3BAR	
8				
9	3BAR	1BAR	1BAR	
10				
11	2BAR	STREAK	STREAK	
12				
13	STREAK	CHERRY	1BAR	
14				
15	3BAR	1BAR	CHERRY	
16				
17	1BAR	STREAK	1BAR	
18				
19	2BAR	2BAR	2BAR	
20				
21	3BAR	1BAR	1BAR	
22				

FIG. 3

BONUS GAME						
SYMBOL	REEL1	REEL2	REEL3			
REDSEVEN	1	1	1			
BLUESEVEN	1	1	1			
3BAR	6	6	4			
2BAR	4	4	5			
1BAR	6	6	6			
CHERRY	4	4	5			
	22	22	22			
	10648					
BONUS GAME PAY SCHEDULE						
COMB	PAY	PROB	EV	PULLS		
REDSEVEN	1500	9.39E-05	0.140872	10648		
BLUESEVENS	500	9.39E-05	0.046957	10648		
ANYSEVEN	100	0.000563	0.056349	1774.667		
3BARS	50	0.013524	0.676183	73.94444		
2BARS	20	0.007513	0.150263	133.1		
1BAR	10	0.020285	0.202855	49.2963		
3CHERRIES	10	0.007513	0.075131	133.1		
ANYBAR	5	0.319309	1.596544	3.131765		
2CHERRIES	5	0.093163	0.465815	10.73387		
CHERRY	2	0.382044	0.764087	2.617502		
		0.844102	4.175056			
BONUS GAME FEATURE						
S=EXPECTED # OF SPINS(WINNING SPINS+1 LOSER TO END FEATURE)						6.414458
X=EXPECTED WIN PER SPIN						4.175056
C=EXPECTED WIN FROM FEATURE						26.78072
BONUS GAME TOTAL						
TOTAL FROM BONUS GAME SPINS						26.78072
TOTAL FROM 2ND CHANCE FEATURE						0.952536
						27.73326

FIG. 3A

PAY TABLE		
COMBINATION	1ST COIN	2ND COIN
RED SEVENS	1500	3000
BLUE SEVENS	500	1000
ANY SEVEN	100	200
3BARS	50	100
2BARS	20	40
1BARS	10	20
3 CHERRIES	10	20
ANY BAR	5	10
2 CHERRIES	5	10
1 CHERRY	2	4

FIG. 7

SECOND CHANCE WHEEL			
PAY	COUNT	PROB	EV
3	32	0.32	0.96
5	45	0.45	2.25
10	20	0.2	2
20	2	0.02	0.4
50	1	0.01	0.5
	100	1	6.11
EXPECTED VALUE OF 2ND CHANCE WHEEL			
6.11			
PROBABILITY OF SPINNING 2ND CHANCE WHEEL			
0.155898			
EXPECTED VALUE ADDED TO BONUS GAME FROM 2ND CHANCE WHEEL			
0.952536			

FIG. 4

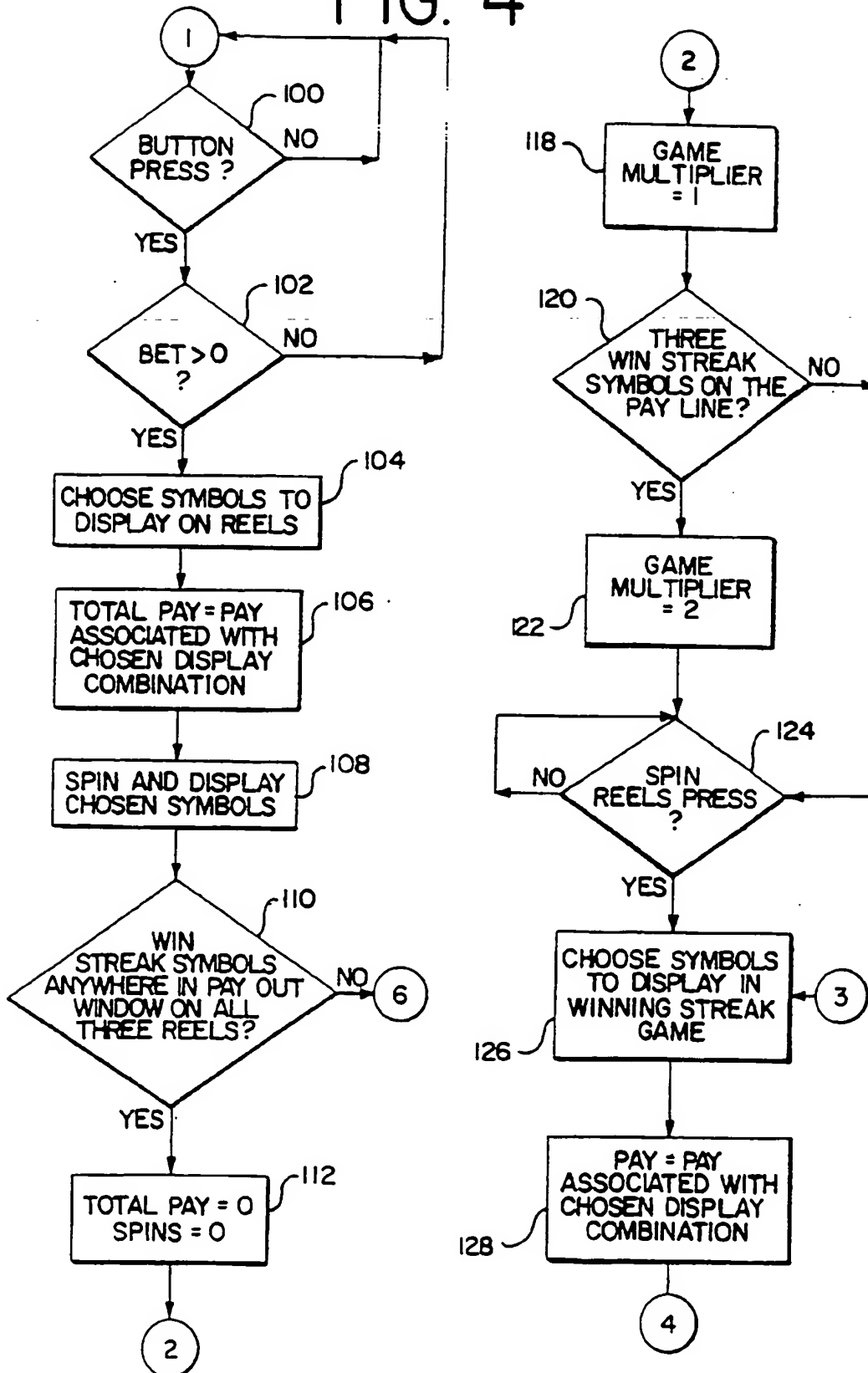
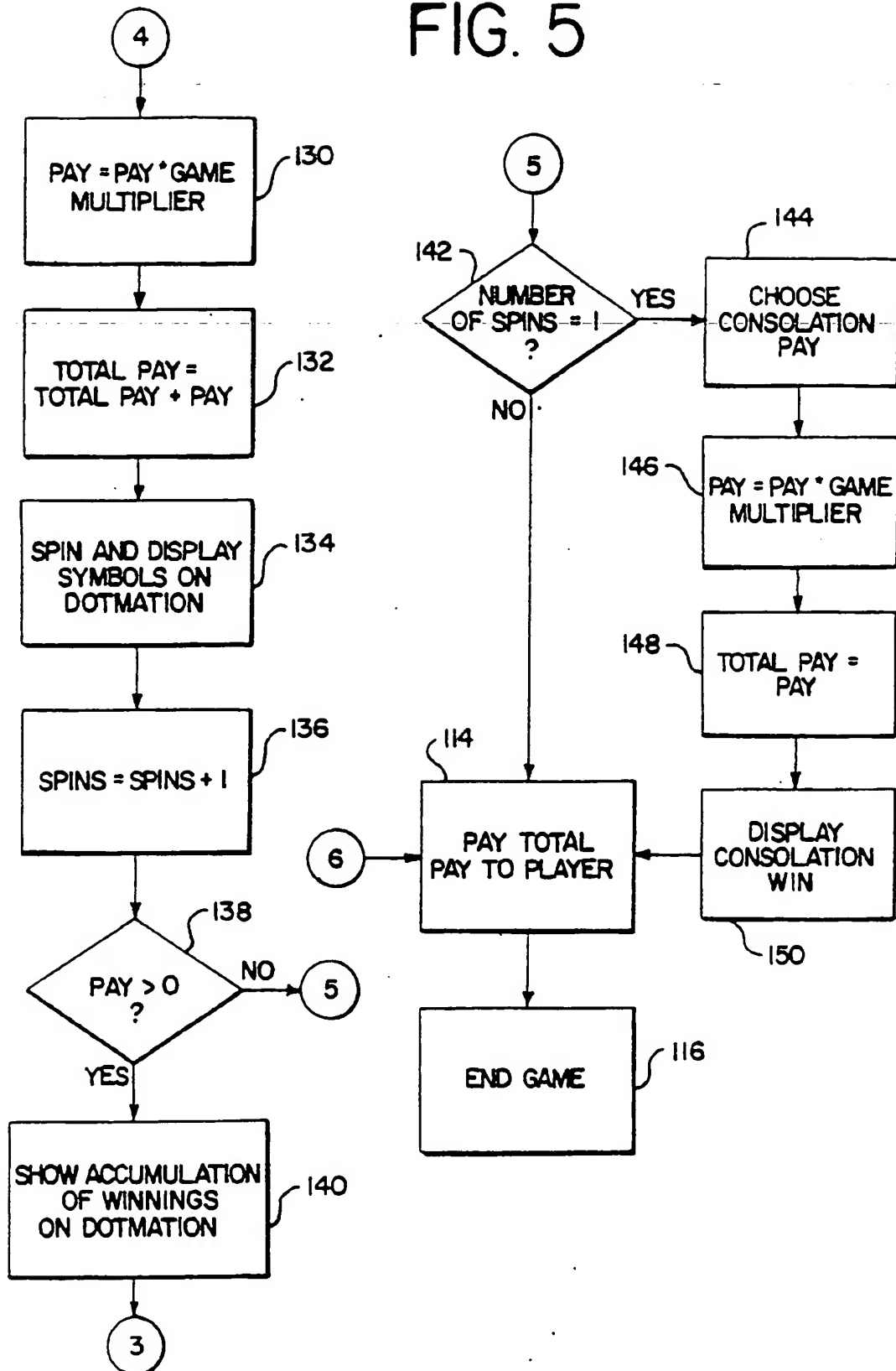
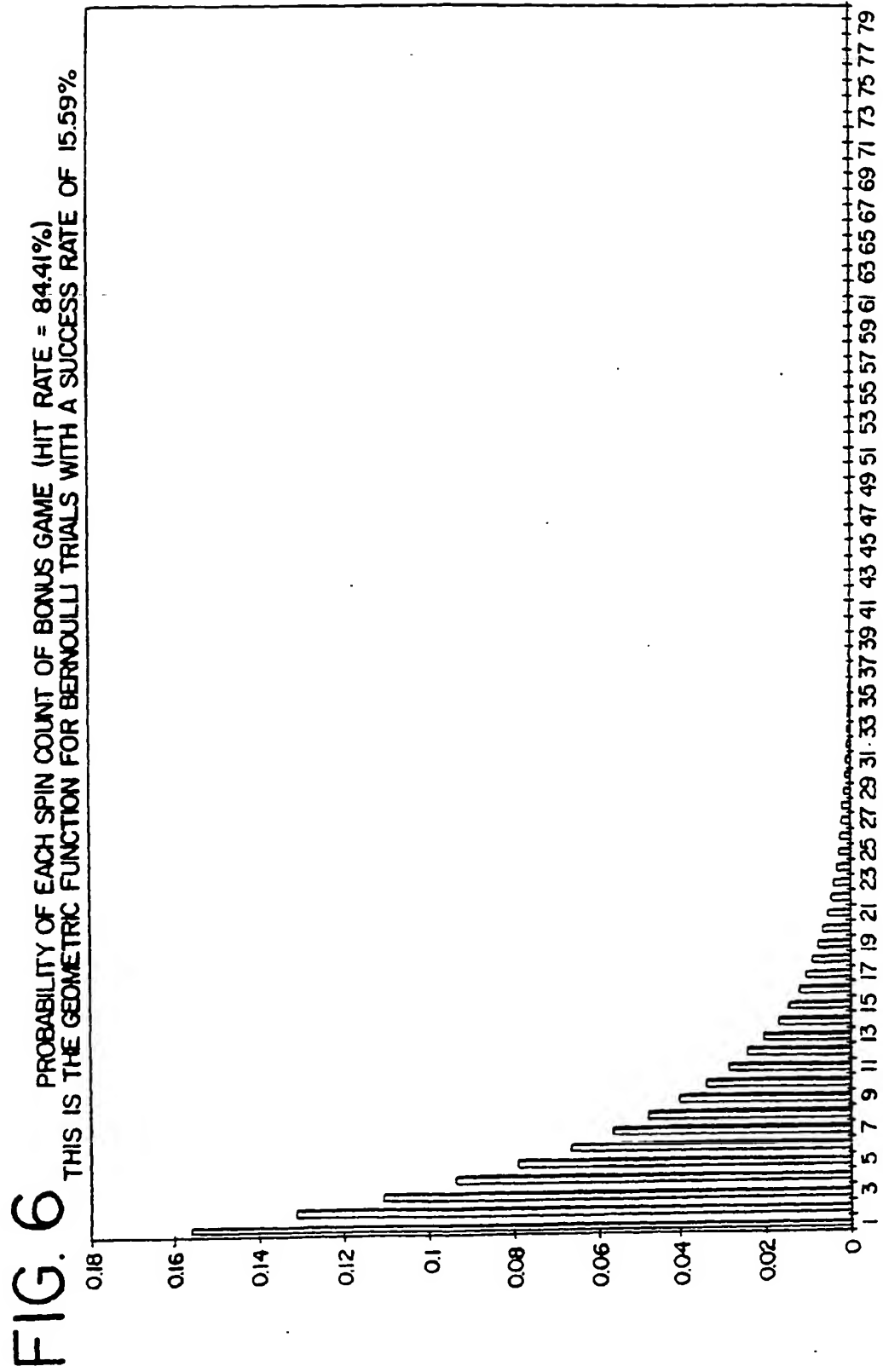


FIG. 5







European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 30 2349

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB 2 084 371 A (BALLY MANUFACTURING) 7 April 1982	1-10, 12-15	G07F17/32
Y	* page 2, line 83 - line 85 * * page 3, line 20 - line 92 * * page 4, line 18 - line 29; figure *	11,16,17	
Y	EP 0 148 001 A (ARTHUR EDWARD THOMAS LTD.) 10 July 1985	11,16,17	
A	* page 7, last paragraph - page 8, line 6; figure *	1-4,7-15	
X	GB 2 180 087 A (BELL-FRUIT) 18 March 1987	1-3, 6-10, 12-14	
A	* page 1, line 21 - line 71 *	4,5,11, 15	
X	DE 36 38 099 A (NSM-APPARATEBAU) 11 May 1988 * column 6, line 41 - column 7, line 2; figure 1 *	1-3,7-9, 11-15	
A	GB 1 129 607 A (LENNARD) * page 1, line 8 - line 40 * * page 2, line 74 - page 3, line 1 *	1-3,8-15	G07F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 13 August 1998	Examiner Neville, D
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			